Mid-Atlantic Integrated Assessment

MAIA

Direction for the 21st Century

DIRECTION FOR THE 21ST CENTURY

Environmental management and protection strategies are changing. The command and control approaches, that have been successful in the past are undergoing review and modification. Single media regulatory and management programs are being phased into cross-media and integrated management efforts. The local-scale environmental problems of the 1970's and 1980's— individual municipal and industrial point source discharges, Superfund and RCRA facilities, oil spills, and thermal pollution—are being addressed. However, as we address and solve

> **STRATEGIC PLAN CONTENT**
>
> - **Direction for the 21st Century - The MAIA Mission and Vision**
> - **Major Themes Integrating Agency Programs in the 21st Century**
> - **MAIA Goals and Objectives**
> - **Making It Happen**
> - **The 21st Century and Beyond**

some of these local-scale problems, we are learning that our individual actions also have cumulative effects at much larger scales. Major environmental problems are no longer just local. Many of our existing and emerging environmental problems are regional and global. Climate change, acid rain, atmospheric transport of mercury and other airborne contaminants, loss of biological diversity, habitat destruction and stratospheric, ozone depletion, are occurring around the world. Strategic alliances, partnering, and cooperative and collaborative efforts are needed at watershed, regional, and global scales to address the emerging environmental issues and problems of the 21st Century. These new strategies are being formulated and instituted not only by the US Environmental Protection Agency (EPA), but also by other resource management agencies at federal, state, and local levels, and by other partners (See Appendix A).

Scientifically sound knowledge is needed to make responsible environmental management decisions at all these scales. The Mid-Atlantic Integrated Assessment (MAIA) project was initiated

to provide this scientific knowledge to decision makers. Achieving the MAIA mission and vision will make a difference in environmental management in the 21st Century.

MAIA Vision

Our vision is a region in which the information age has matured into the knowledge age. Environmental decisions are based on knowing the state of the environment for all ecological resources in the region. Information on natural resources is integrated with information from the socioeconomic sector so that

> **MAIA MISSION**
>
> **To inject integrated scientific knowledge into the environmental decision-making process for the Mid-Atlantic region.**

impacts caused by human activities can be cost-effectively identified and addressed. Decisions are based not only on evaluating the risks to human health, but also the risks to ecological health. Integrated watershed management programs have been implemented because the need to protect, manage, and restore ecosystem function and diversity has been clearly communicated to the public. More over,

1) There is a strong and effective collaboration among all groups in the region; citizens, government, business, and academia work together as partners to resolve environmental issues in a socioeconomic context.

2) The Mid-Atlantic region is the proving ground for the development and implementation of innovative approaches to environmental management through these collaborative efforts.

3) Ecological, social, and economic information is integrated, assessed, clearly communicated to decision makers, and used in the environmental decision-making process.

4) The undesirable legacies of the past are gone and ecosystems have been sustainably restored to provide recognizable benefits, goods, and services to society. Industrial ecology and natural ecology are two sides of the same coin, maintaining a sustainable environment.

5) Citizens of the Mid-Atlantic region are well-educated stewards of the environment, who understand the interconnections of economic, social, and environmental health. This understanding is illuminated in the actions that are taken.

Mid-Atlantic Region

The Mid-Atlantic region is an area of historical, cultural and ecological significance and economic importance. The Mid-Atlantic region encompasses over 120,000 square miles and extends from the Atlantic Ocean on the east to the Ohio River on the west, from New York in the north to North Carolina in the south (Figure 1). The Mid-Atlantic region is a little larger than EPA Region III and contains the states of Delaware, Maryland, Pennsylvania, Virginia, and West Virginia in their entirety,
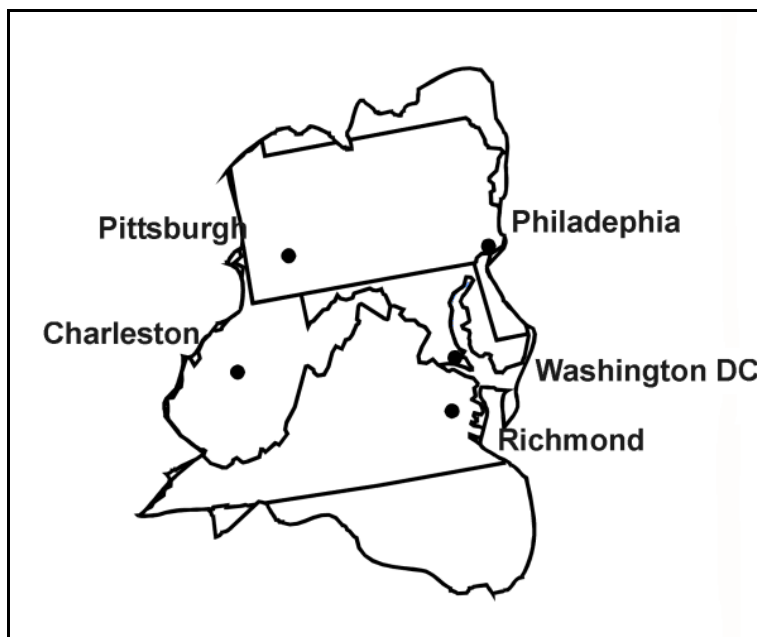

Figure 1. Boundaries of the Mid-Atlantic region. MAIA fully encompasses five states and includes parts of NY AND NC. Note the district ecorgeions in the Mid-Atlantic.

and portions of New York, New Jersey, and North Carolina. The Mid-Atlantic region contains a mosaic of ecological systems on the landscape—lakes, streams, forests, agricultural areas, wetlands, and estuaries. In addition, it is home to over 25 million people.

The Mid-Atlantic has all of the attendant environmental problems associated with human activities including air pollution (ozone, acid rain); water quality problems (eutrophication, acid mine drainage); solid waste disposal problems (landfill leachate); large-scale habitat alteration from urbanization, agricultural, and forestry management practices; hydrologic modifications, such as dams and stream channelization; loss of biotic diversity; and threatened and endangered species. Ecological restoration efforts have been initiated in some areas to restore damaged ecosystems. The Mid-Atlantic region is representative of other regions, and geographic areas, across the US with similar environmental problems and issues. Therefore, solutions to the environmental problems in the Mid-Atlantic region should be transferrable to other geographic areas.

MAIA

The Mid-Atlantic Integrated Assessment (MAIA) is an interagency, multidisciplinary program that is integrating and assessing research and monitoring information to provide answers to policy and management questions. The MAIA project is trying to move from information overload to providing managers and decision makers with the relevant and necessary knowledge to make sound environmental decisions. Scientific projects conducted in MAIA are focused on policy and management issues of critical importance to resource managers and environmental decision makers. In its 3 years of existence, MAIA has forged alliances with other federal and state agencies, producing an array of useful products on the ecological condition of estuaries, streams, groundwater, and landscapes, as well as other related topics. In the next century, MAIA will build on this foundation and create an arena in which innovative approaches for environmental assessment and management can be proven, implemented, refined, and subsequently, communicated and transferred not only to MAIA partners and alliances, but also to other EPA Regions, federal, state, and local agencies.

The MAIA Mission is to inject integrated scientific knowledge into the environmental decision-making process for the Mid-Atlantic region. The current reality is that the decision process considers the political, economic, social, and scientific consequences of environmental decisions. In the absence of good, integrated information, politics or other considerations are the first order of business (Figure 2). The assessment archetype or desired approach is that consequences of environmental decisions of "Take Action" or "No Action" be anchored on scientific, social, and economic knowledge (Figure 2). The goal is to provide knowledge about the ecological, social, and economic consequences of management actions so that informed decisions can be made. Collecting the right data and then integrating ecological and socioeconomic information and communicating this knowledge so that it contributes to environmental decision-making represents the major challenge for MAIA.

MAJOR THEMES INTEGRATING AGENCY PROGRAMS IN THE 21ST CENTURY

As our environmental perspective has moved to the watershed, regional, and global scale, it has become apparent that our environmental problems are interrelated. Emission controls solve air

Decision Process

Current Reality   **Assessment Archetype**

Factors

Political
Implications

Economics

Social
Impacts

Scientific
Evidence

Direction

Current Reality

Decision

Positive   Negative

C>B*   B>C   C>B

Minority Majority Minority Majority

Supporting   Not Supporting

Direction

Assessment Archetype

Decision

Positive Negative

C>B   B>C   C>B

Minority Majority Minority Majority

Take Action   **No Action**

———————   Easiest decision pathways

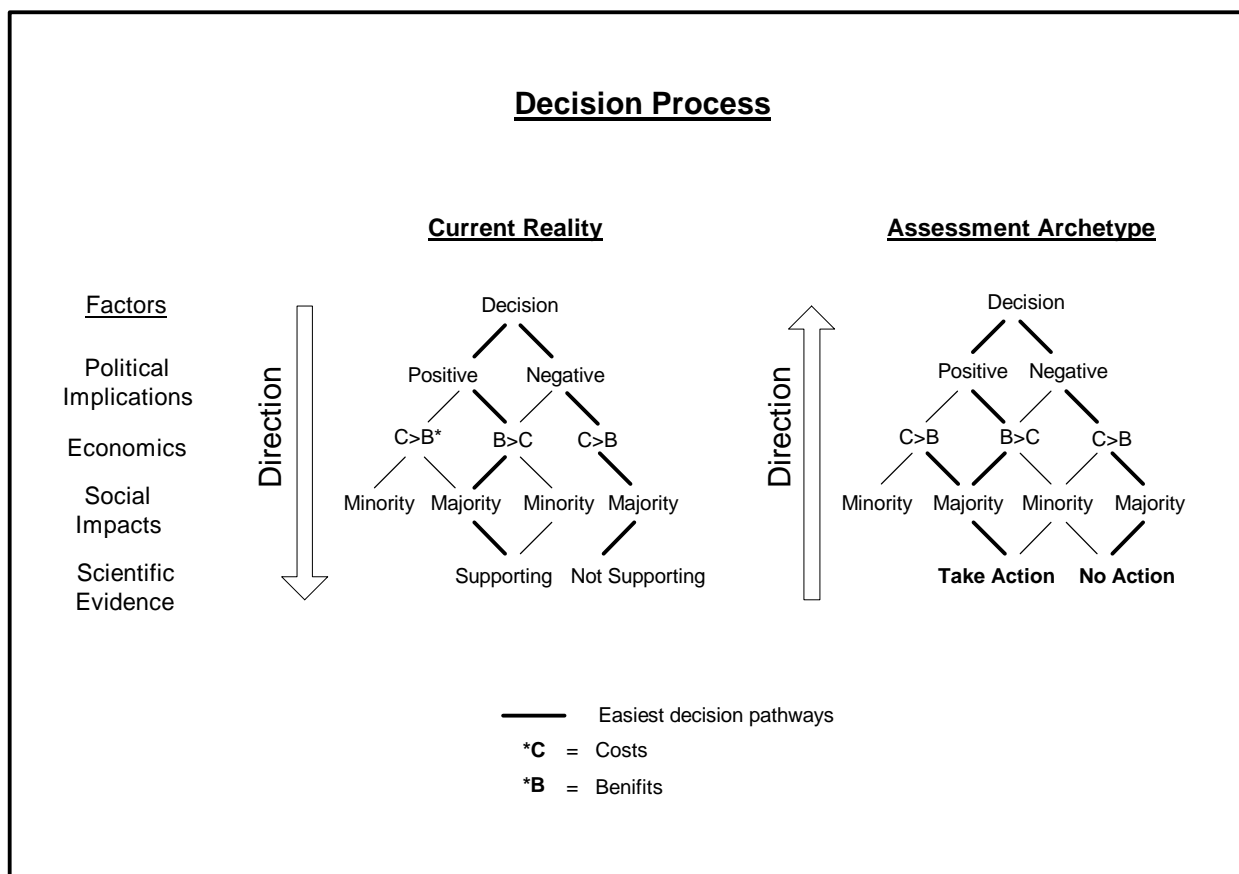***C** = Costs

*B = Benifits

Figure 2. Decision process contrasting current reality versus the desired assessment archetype.

problems, but lead to solid waste and groundwater problems (e.g., disposing of fly ash and its leachate). Removing phosphorus from wastewater treatment plants reduces eutrophication, but creates sludge disposal problems. Burning municipal waste reduces the solid waste problem, but contributes to fish consumption health advisories from mercury contamination because atmospheric mercury from this burning is deposited in our aquatic ecosystems and taken up through the food chains. There are many pieces to the environmental jigsaw puzzle and we need better information and knowledge to determine where and how these pieces fit together. MAIA represents one approach for putting pieces of the puzzle together so that multiple major environmental themes or objectives can be accomplished within the Mid-Atlantic region (Figure 3).

Eight major themes have been identified for the Mid-Atlantic region (Figure 3). These themes, which support and integrate EPA Region III's Environmental Priorities and the EPA Office of Research and Development (ORD) Strategic Goals (EPA 1997) (page 7, also see Appendix B), have

also been identified by other stakeholders in the Mid-Atlantic region as being important in the next century (e.g., Pennsylvania 21st Century Environment Commission, 1998).
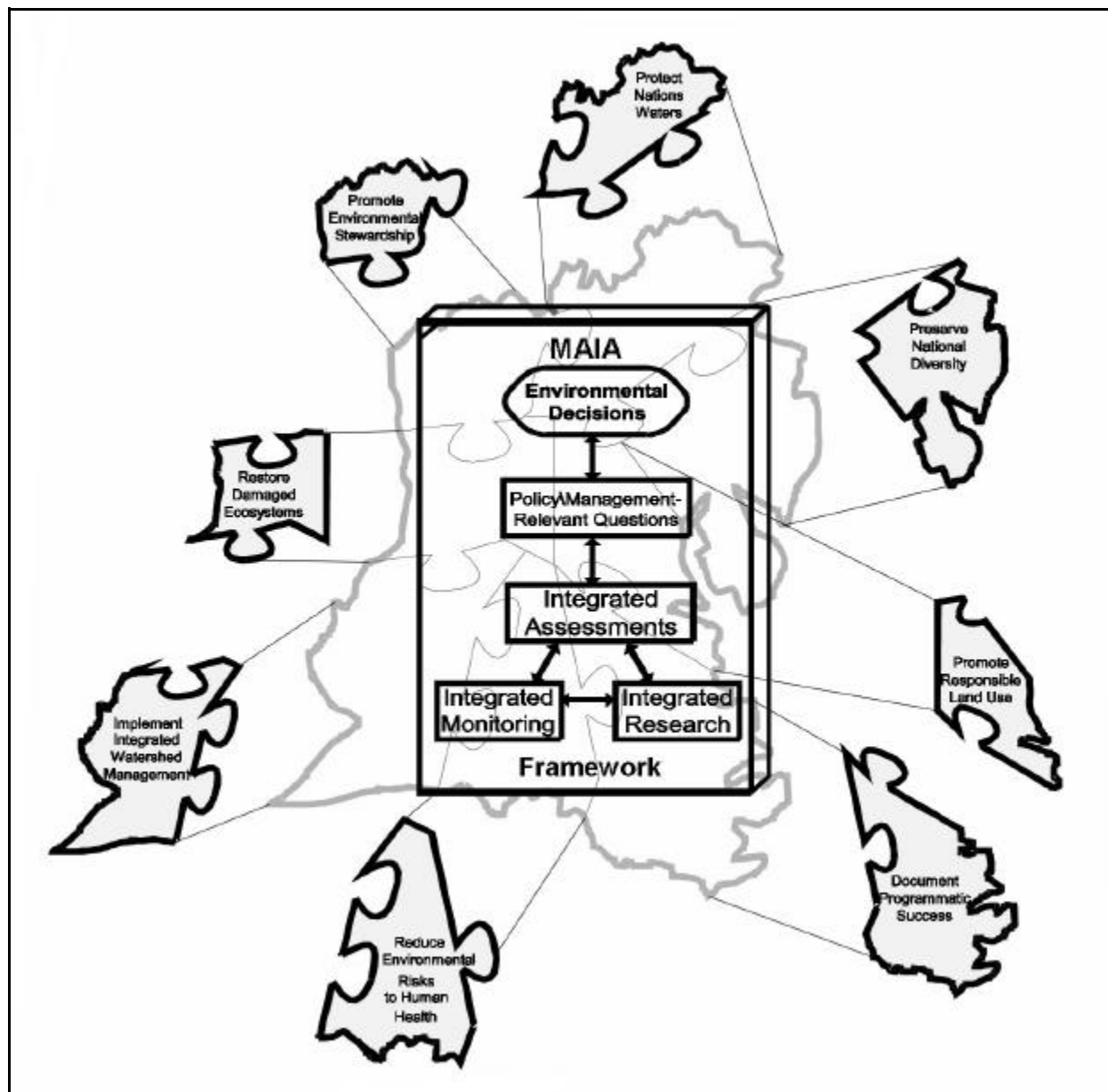

Figure 3.   The MAIA Framework contributes to putting the environmental puzzle together for the Mid-Atlantic region.

REGION III ENVIRONMENTAL PRIORITIES

1) **Chesapeake Bay and Other Estuaries**
2) **Impacts of Acidification**
3) **Ozone**
4) **Cities/Urban Environment**

This holistic integrated approach to environmental management highlights some of the themes that are essential for sound environmental management and protection. These themes range from promoting environmental stewardship through education, protecting the nation's waters by integrating groundwater and surface water management, preserving natural diversity, promoting responsible land use through integrated watershed management, restoring damaged ecosystems to reducing environmental risks to human health and documenting the success of these efforts in satisfying Government Performance and Results Act (GPRA) performance measures (Figure 3). GPRA was enacted on August 3, 1993, to provide for the establishment of strategic planning and performance measurement in the Federal Government. The intent of GPRA is to change the culture of federal agencies from focusing on what agencies are doing to what agencies are accomplishing. The Act requires agencies to develop strategic plans, reach a reasonable degree of consensus on desired goals with key stakeholders, and measure and report progress toward achieving those goals (see sidebar on page 9, Appendix C). The goals and objectives of MAIA will contribute to accomplishing these themes within the Mid-Atlantic region. Studies have already been initiated that are providing results and products that can, and are, contributing information for environmental decision making.

ORD STRATEGIC GOALS

1) **Develop Scientifically Sound Approaches for Assessing Risks.**

2) **Develop a Comprehensive Multimedia Assessment Methodology.**

3) **Provide Common Sense, Cost-Effective Approaches for Preventing and Managing Risks.**

4) **Provide Credible, State-of-the-Science Risk Assessments, Methods, Models, and Guidance.**

5) **Exchange Reliable Risk Assessment/Risk Management Information.**

6) **Provide Leadership in Identifying, Assessing, and Reducing Risks from Emerging Issues.**

MAIA GOALS AND OBJECTIVES

Goal 1: Integrated Assessment of Environmental Data

Agencies routinely prepare assessments on the status of ecological resources (e.g., streams and forests) to meet their current missions and mandates. However, a critical need exists to integrate this information to increase our understanding of the significance of interactions among resources, their links to variations in the natural and human

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MAIA GOALS

1)  Integrated Assessment of Environmental
    Data
2)  Integrated Monitoring
3)  Environmental Restoration
4)  Communication of Scientific Results
5)  Use of Environmental Assessment in
    Decision Making
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environment, and their responses to multiple drivers of change. These integrated environmental assessments should identify environmental and ecosystem trends, relate these trends to their causes and consequences, and predict outcomes of alternative management scenarios. Three objectives have been identified to achieve this goal.

Objective 1: Produce Individual Ecological Condition Reports on the Mid-Atlantic Resources. These peer-reviewed reports will gather and evaluate the best available scientific information and knowledge about ecological resources such as estuaries, streams, and forests. The reports will employ the latest scientific tools, and draw upon carefully designed monitoring programs that provide broad coverage of all ecological resources. These reports will demonstrate the value of forging close scientific collaboration among federal and state agencies and other organizations.

Objective 2: Integrate Individual Integrated Environmental Assessments For Determining Cumulative Impacts. These assessments will "tell a story" about the cumulative effects or impacts that emerge because of the interactions among ecological resources on the landscape. The landscape is a mosaic of interacting ecological resources. The condition of terrestrial

resources affects the condition of freshwater ecosystems, which collectively affect the ecological condition of estuarine ecosystems.

Objective 3: Develop and Support Themes Using Integrated Assessments of Environmental Data. In order to truly promote sustainable ecosystems, we must link models of ecosystem health with models of socioeconomic forecasting and human health. MAIA will develop the integrated risk assessment methods and models that take into account ecological processes, current and future conditions, human demographics, institutional factors, human preferences, and human health for both marketable and nonmarketable ecosystem goods and services based on the eight regional themes.

Goal 2: Integrated Monitoring

Ecosystems are not made up of a set of separate and independent ecological resources. Instead, these resources interact in ways that ultimately determine ecosystem condition. Current environmental monitoring programs, although effective at tracking specific components of ecosystems, are considered by many resource managers to be inadequate in providing critical information on how habitat, physical, chemical, and biological components interact. Information quality and quantity also vary widely within MAIA (state-by-state, county-by-county). Four objectives have been identified to help achieve this goal.

GOVERNMENT PERFORMANCE & RESULTS ACT (GPRA)

All federal agencies are required to better account for the success of their proposed actions. EPA has developed a cascading set of goals, objectives, milestones, measures, tasks, and products in compliance with GPRA. Ten EPA strategic goals to satisfy GPRA objectives are:

1) Clean air;
2) Clean, safe water;
3) Safe food;
4) Safe communities, homes, work places, and ecosystems;
5) Safe waste management;
6) Global and transboundary environmental risk reduction;
7) Empower people with information and education, and expand their right to know;
8) Provide sound science to improve understanding of environmental risk, and develop and implement innovative approaches for current and future environmental problems;
9) Provide a credible deterrent and promote compliance; and
10) Effective management.

The MAIA themes and framework are directly linked to these EPA goals.

Objective 1: Inventory Monitoring Programs. As a starting point for the development of an integrated monitoring program, one must know what is being monitored, where monitoring is taking place (spatially and temporally), and why (management issues).

Objective 2: Evaluate Adequacy of Monitoring Network. Monitoring is essential for assessments of natural resources and for modeling potential management effects over different scales in time and space. Existing environmental monitoring programs will be evaluated based on their capability to determine the status of society's environmental values; determine changes and trends in ecological indicators; establish relations among causes and effects; provide insight into emerging problems; and provide information to evaluate the effectiveness of environmental policies and management practices.

Objective 3: Design Individual Resource Monitoring Networks. Within the MAIA framework, the three tiers of monitoring (remote sensing, regional surveys, and integrated site-specific monitoring), proposed by the interagency Committee on Environment and National Resources (CENR), will be designed and conducted in a coordinated fashion for individual ecological resources, allowing the full range of integration that has not been previously possible.

Objective 4: Design Integrated (Multiple Resource) Monitoring Networks. The proposed MAIA framework provides an opportunity and challenge in integrating information from multiple ecological resources, taken at multiple spatial scales and over varying temporal scales to describe the sustainability and integrity of the Mid-Atlantic ecological resources.

Goal 3: Environmental Restoration

Once we understand how the various components of ecosystems interact, we will be able to identify critical components that should be restored; to evaluate and assess the risks (ecological, social, economic, and political) associated with different management alternatives; and to design and implement effective and efficient restoration projects. Three objectives are identified to achieve this goal.

Objective 1: Develop Research Strategy. Ecosystem restoration research projects will be planned and designed to provide information not only on the effectiveness of various approaches for restoring ecological structure and function for individual resources, but also on reducing cumulative impacts at watershed and basin scales.

Objective 2: Inventory Eco-Restoration Projects in the Mid-Atlantic Region. An inventory will be conducted to determine the goals, objectives, success criteria, restoration practices, longevity, and location of historical and on-going ecosystem and habitat restoration programs in the Mid-Atlantic region. Interagency opportunities for cooperative and collaborative studies will also be a focus of the inventory.

Objective 3: Integrate Ecological Restoration Into The Landscape. Ecological restoration projects will be designed and implemented from a landscape perspective. The location of eco-restoration projects will be targeted for areas on the landscape where there will be the greatest cumulative benefit to the environment.

Goal 4: Communication of Scientific Results

The MAIA customers include federal, state and local government resource managers, scientists and decision makers; non-governmental organizations; academic organizations; private industry, and the general public. Two objectives have been formulated to help achieve this goal.

Objective 1: Increase Visibility and Usability of Products/Reports. MAIA will use a variety of communication and transmission media to provide information and knowledge in a format that is useable for environmental decision making. The media will be tailored to client preferences, agency protocols, and public forums.

Objective 2: Improve the Quality and Accessibility of Environmental Data. MAIA will take advantage of the explosion in Internet and digital technology, EPA STORET improvements, and computer access to increase the accessibility of environmental data. Revised and updated

data quality objectives and quality assurance/quality control procedures will be incorporated in MAIA to ensure the quality of the information is sufficient to answer policy and management questions.

Goal 5: Use of Environmental Assessment in Decision Making

Federal, state, and local strategic planners will use the information developed by MAIA to make sound scientific decisions to further protect human health and the environment. One objective has been identified to help achieve that goal.

Objective 1: Develop Decision-Making Models Using Environmental Assessments. Effective use of MAIA information in decision making will be aided by the development of templates or models to illustrate how the information provides answers to policy and management questions and how it can be used in the decision-making process. These models will be based on insight and input from decision makers on how decisions are made.

Products and tasks associated with each of these goals and objectives are provided in Appendix A. The schedule for product production also is included in the appendix.

MAKING IT HAPPEN

Simply saying it doesn't make it so. To make these goals and objectives happen, strategies for performing integrated assessments through integrated research and monitoring, and for communicating the results from the assessment to the clients, are needed. In addition, a strategy is needed for identifying, prioritizing, and developing clients who will use the MAIA assessment information in decisions. Previous Region III Community Based Assessment Team efforts have focused on forming the strategic alliances necessary to implement environmental management and protection programs and promote stakeholder and public education on environmental stewardship. These strategic alliances are a cornerstone of the MAIA initiative and will continue as part of the overall MAIA strategy.

A major part of the MAIA Framework is interacting with the client to identify the questions that need answers before decisions can be made (Figure 3). The question formulation process must begin at the decision makers level, not at the scientist level. Policy and management questions, in many instances, are formulated by the scientists or engineers based on what they know and can do, rather than what is needed by the decision maker. The policy and management questions will be developed in a hierarchy from general questions such as, "How extensive is habitat destruction in the region?" through more specific, detailed questions such as "Which habitat indicators should be monitored?" "What range of indicator values define good, marginal, and poor habitat conditions?" This will ensure the right information is provided in the answers to these questions. Formulating the right questions is a critical interface between the environmental decisions to be made and the integrated assessments that provide this information and satisfy client needs.

Integrated Assessments

The MAIA Program has developed a framework for conducting integrated assessments at four different levels (Figure 4). Each of the levels provides information that is useful in environmental decision making, but the levels build in the complexity of the questions, necessary information, and assessment approach. The Level Four integrated assessments are intended to ultimately provide answers to questions such as, "What is the state of the environment in the Mid-Atlantic region?" One strategic goal is to develop the tools and procedures for working through each of the four levels of integrated assessments.

Level One

Level One integrated assessments provide information on individual ecosystem condition or on specific high interest subjects, such as sport fish, song birds, or estuary eutrophication. An integrated assessment of Mid-Atlantic estuarine condition and a Mid-Atlantic Landscape Atlas have both been published. An integrated assessment, reports on Mid-Atlantic forests and streams are in preparation. These documents were prepared through joint MAIA and stakeholder efforts, building partnerships and alliances with agencies in the Mid-Atlantic region. The Level One integrated

Level One-Resource Condition

Streams   Wetlands*
Forests   Landscape
Agro ecosystems -Land use
Estuaries   -Birds

Level Two-WithIn Resource Group Associations

Streams
-IBI   -Aq. Insects
-Nutrients   -AMD
-Habitat   -Acid Rain

Level Three-Landscape-Resource Integration

Streams   Land Use/land cover
-Biota   -% Forested
-Water chemistry -% Impervious
-Habitat   -Forest Fragmentation
               Index

Level Four-Multi-Resource Integrated Assessment

Conditions and Interactions
-Forest   -Streams
-Agroecosystem -Estuaries
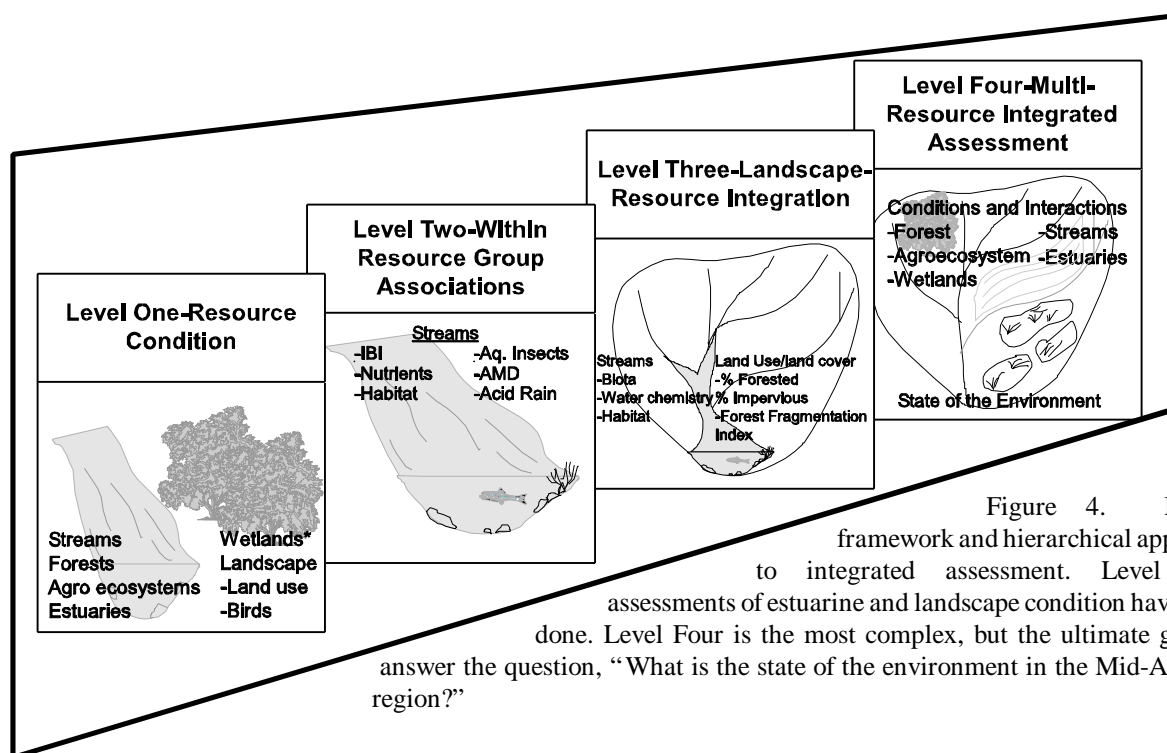-Wetlands

State of the Environment

Figure 4. MAIA framework and hierarchical approach to integrated assessment. Level One assessments of estuarine and landscape condition have been done. Level Four is the most complex, but the ultimate goal to answer the question, "What is the state of the environment in the Mid-Atlantic region?"

assessments provide information on the status, extent and trends in resource condition, but do not address the "why" questions. Although Level One assessments are at the base of the assessment hierarchy, the information can be used to assess the biological and habitat diversity of the individual ecological resource, contribute to integrated watershed management programs, and document the success of current environmental management programs. Level One assessments also indicate the progress that is being made in existing programs, permitting measures of success against GPRA goals. Estimates of resource condition and the patterns in this condition have contributed to public environmental education at the watershed and regional scales.

Level Two

Level Two integrated assessments begin the process of answering the "why" questions by looking at the associations among chemical and habitat indicators and biological effects or ecosystems. The Level Two assessments evaluate resource condition using physical and chemical indicators collected with the biological indicators in specific ecological resources such as streams,

estuaries, or forests. The Level Two integrated assessments provide information useful in addressing all the MAIA environmental themes in for the Mid-Atlantic region (Figure 4).

Level Three

Level Three integrated assessments focus on assessing the effects of watershed land use and land cover on the ecological resource condition. The Level Three assessments provide specific information not only on condition of the ecological resource, but also the impacts of the watershed on the resource. Integrated and unified watershed assessments can build on these individual ecological resource assessments and identify regulatory or management actions that might be taken to reduce these ecological effects. In addition, Level Three assessments can be used to identify, prioritize, and to target watershed restoration efforts on damaged ecosystems. Level Three assessments also will predict the effects of land use changes on ecological resource condition, to answer the "what if" questions related to land use. The Level Three integrated assessments contribute to the MAIA environmental themes by providing land use/land cover information at the watershed and regional scales and its association with the condition of the ecological resources of interest.

Level Four

Level Four integrated assessments represent the analysis not only of watershed-ecological resource interactions, but also the interactions among ecological resources. For example, a Level Four integrated assessment would address the question, "What is the condition of the environment in EPA Region III?" Level Four assessments consider the interactions among forest, agriculture, wetland, stream, lake, and estuarine ecosystems on the landscape at watershed and regional scales. The Level Four integrated assessments ultimately provide the information needed for the development of integrated watershed management programs and demonstrate the importance of environmental stewardship and responsible land use management practices. The Level Four assessments also will document the success of environmental management programs.

Products

Several products are already available at Level One and more products will be available within the next several years (See Appendix A). The Level Two and Level Three integrated assessments are in the process of being conducted. Level Four integrated assessments currently are in the conceptual stage. These integrated assessments use information from integrated monitoring and research programs.

Integrated Monitoring

A major part of the information needed for integrated assessments at the regional scale is being provided through the EMAP program. The importance of this program is illustrated by Figure 5, which shows the scale at which monitoring programs are being conducted by different states and other federal agencies. Without the EMAP monitoring network, there would be a significant hole in the information available for regional assessments. EMAP complements the other, on-going monitoring programs. Each of these monitoring networks provides information that is needed for an integrated perspective and assessment of the state of the environment at all scales. Eliminating any of these monitoring networks creates a hole in needed information.

The MAIA strategy for integrated assessments is to develop procedures for using existing data from other programs to supplement the EMAP data, particularly for spatial maps and displays. Different monitoring programs have different objectives and, consequently, use different collection methods and measure different environmental indicators. Several studies are currently under way to evaluate approaches for integrating information from different programs and merge it into a common format so that different perspectives (e.g., watershed, ecoregion, region) on ecological condition can be attained based on all available data. These efforts will continue as part of the four levels of the integrated assessments.

Integrated Research

These integrated assessments are possible because of several unique partnerships that have already been formed within the Mid-Atlantic region. The Mid-Atlantic Assessment Team, located in
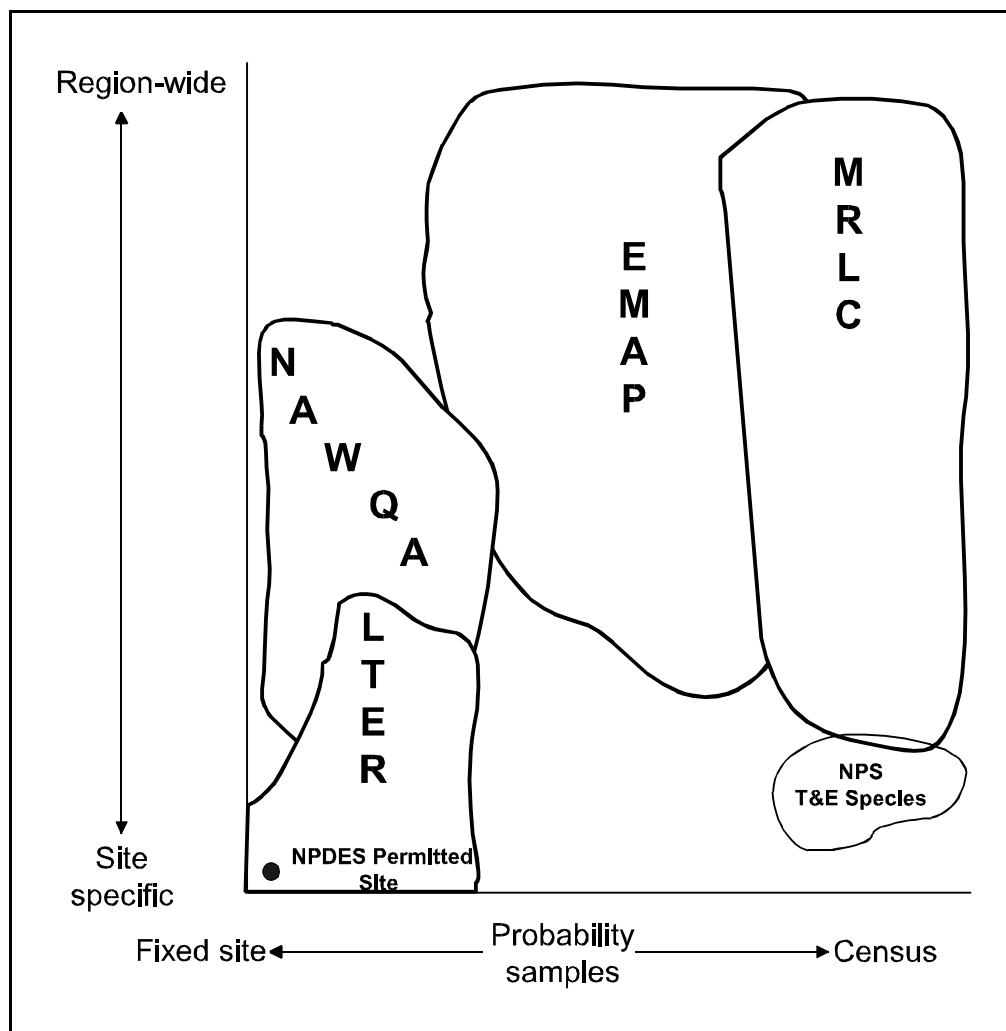
Figure 5. Spatial coverage and capability of making statements about the condition of the resource (e.g., census) versus individual sites (i.e., fixed sites) for different monitoring program coverages. All these programs are needed to assess the state of the environment.

Annapolis, MD, was created as a joint venture between the EPA Office of Research and Development and EPA Region III. One of the major objectives of the team is to create partnerships with other federal, state, and local agencies and universities in the conduct of ecological research and assessments. The team has successfully accomplished this goal by creating partnerships through formal and informal arrangements with most of the federal and state agencies with responsibilities for environmental issues in the Mid-Atlantic region.

A research partnership also recently formed among the three major research laboratories within the EPA. The ecological components of the National Health and Ecological Effects Research

Laboratory (NHEERL), the National Exposure Research Laboratory (NERL) and the National Risk Management Research Laboratory (NRMRL)—all of the Office of Research and Development—have agreed to join together to focus their considerable research capabilities on environmental restoration problems in the Mid-Atlantic region.

Each organizational unit brings their discrete expertise to bear upon this approach to ecological restoration research. NHEERL has responsibility for EMAP, which is a research program focused on estimating the condition of ecological resources. NERL has responsibility for chemical and other stressor research, including a substantial landscape characterization and ecology research program. NRMRL has responsibility for ecological restoration research.

A formidable research capability, therefore, emerges when the above EPA components are joined with the research capacities of other federal and state agencies. The strategy is to continue to build this network and maintain a research element as part of the integrated assessments so that new and innovative techniques and approaches can be incorporated in future assessments.

Communication

The ultimate assessment goal is to provide information that is used in the decision-making process. MAIA results and information must:

- Satisfy the client's needs,
- Convey important information relevant to their assessment questions and issues, and
- Be understandable and useful in making management decisions.

EPA's primary customer is the general public. Everyone who lives on the land, breathes the air, and shares in the earth's environment represents the ultimate EPA customer. In addition to the primary customer, there are intermediary clients that are critical for success. To serve the public and meet their needs, the MAIA program works on a regular basis with its partners. The ultimate success of MAIA depends on how effectively we work with, and influence the actions of, the many other parties that are responsible for protecting the environment - international, federal, state and local governments; industry, agricultural and small businesses; environmental and nonprofit organizations; and individuals.

To satisfy these customers needs, effective communication of assessment information must consider:

- Audience perspective,
- Message format,
- Transmission medium, and
- Feedback mechanisms.

Audience Perspective

There are going to be multiple audiences for the assessment information and each audience will have a slightly different perspective and background. How people perceive information is critically important in how they process information and the format in which the information is presented. These perspectives, therefore, must be identified as part of the stakeholder and alliance interactions. These various perspectives will be identified and evaluated as part of the question formulation sessions, through various meetings that occur with the stakeholders, and by providing early assessment results. The MAIA Team will solicit input and assistance from disciplines such as social psychology on how different audiences perceive and process information. The Meyers-Briggs test, for example, examines how individuals receive and process information. Similar tools or techniques will be used to determine client perspectives of assessment information.

Message Format

While the specific message format depends, in part, on the questions being asked and the client's or users' perspective, there are some general concepts that will be developed to assist in the preparation of the answers to the questions (i.e., the specific messages being sent). A decision makers survey conducted as part of the Southern Appalachian assessment found that two-thirds of the environmental and resource managers wanted information that was concisely summarized and not highly technical (EASE 1994). These managers wanted specific statements of potential environmental impact, whenever possible. Information that was too general, or that was conflicting, was not useful in the decision-making process. In addition, most decision makers were skeptical of assessments that were based on a high degree of interpretation on limited site-specific data that was extrapolated to larger areas.

There are on-going studies that are developing approaches for formatting, displaying, and presenting assessment information so that the message is clear and interpretable. These studies are building on the pioneering work of Tufte (1983, The Visual Display of Quantitative Information). The MAIA EMAP stream data is being used to experiment with other display formats. Different display procedures and formats will be tested using selected clients and stakeholder groups with different questions and perspectives.

Transmission Medium

The transmission medium is central in communicating assessment information. The traditional approach using reports, journals, and similar printed matter is no longer effective as the only medium for today's decision makers. Alternative mediums are needed to convey knowledge to different audiences:, videos and films, computerized systems Web Sites, Internet, (CD-ROMS, decision support systems), fact and briefing sheets, with virtual reality approaches (holograms, and computer systems) quickly becoming feasible for presenting information on ecological condition (Figure 6). The EMAP Landscape Characterization Group has been conducting a research project with the University of Minnesota-Duluth to develop a virtual reality program for displaying landscape scenes in three dimensions. Multimedia approaches will be used in the future to transmit assessment messages. MAIA will be the prototype for testing, refining, and implementing new multimedia approaches for presenting assessment information.

Feedback Mechanisms

The final step in the communication strategy is to ensure the message provided what the user or client needed. Focus and user groups have already been established by some of the MAIA resource teams (e.g., the Estuarine Resource Team). Additional groups will be established to provide feedback on communication approaches being used to present assessment information to a variety of audiences. Surveys and retrospective case studies are proposed as part of the communication strategy to determine how different audiences responded to information presented in previous assessments, if the information satisfied the users needs, how the information was used (or if it was used) in the decision process, and how communication could be improved in the future. These

Figure 6.   Multimedia approaches are critical for communicating MAIA information to multiple audiences in the region.

studies will also include how clients perceive other communication vehicles for receiving information and how they use this information to make both personal and professional decisions.

Clients

The strategy for identifying clients and client needs is to follow a marketing approach typically used in the business sector. Marketing is the compilation and analysis of information about potential clients or customers and their needs for products or services. The purpose of a market plan is to identify the need of the clients and develop or match that need with a product. Potential clients for MAIA information include, for example, Region III Air Protection, Water Protection, and Environmental Services Divisions; Chesapeake Bay Program; and Offices of Reinvention and the Regional Administrator. Other clients would include the EPA Program Offices; other federal agencies, such as NOAA, FWS, and USDA Forest Service and NRCS; state regulatory and natural resource management agencies; non-governmental organizations, watershed alliances; and the general public. The general marketing approach is:

- Identify potential clients related to MAIA themes and products.

- Determine the decision maker in each division, office, or agency.

- Prioritize clients by current needs that can be satisfied with existing MAIA information, magnitude of the problems, visibility of the client and problem, applicability to other clients, and potential for long-term alliance.

- Determine the critical drivers for the decision and the decision criteria (See Figure 1, for example, on factors contributing to decisions).

- Cross-walk MAIA products with critical client decision criteria.

- Select one issue that can be "solved" for the client and provide needed information as an entree into the client's organization.

- Interact with the client using the solution to illustrate how MAIA information can be injected into the decision-making process.

- Build the relationship with the client and network with other decision makers in the organization and associates.

This strategy is initially being implemented within the EPA Region III Divisions and will be expanded to other EPA Offices and federal agencies that have resource management and protection responsibilities and the need for integrated assessment information. Client development will continue with other stakeholders through the strategic alliances formed to address various environmental themes.

THE 21ST CENTURY AND BEYOND

Information dissemination—TV, Internet, e-mail, video, CD-ROM—is undergoing exponential growth. The average American worker now spends about 2 hours per day responding to e-mail. However, disinformation and information overload are expanding as rapidly as useful information. Resolving watershed, regional, and global scale environmental problems requires ecological effects and causes at these scales and the environmental consequences and socioeconomic costs and benefits of different management alternatives to address these problems. Injecting integrated scientific knowledge into the environmental decision-making process for the Mid-Atlantic region will become even more important in the 21st Century. Environmental decision-making will always include political, economic, social, and environmental considerations. Part of the MAIA vision is to provide knowledge by integrating information on the environmental, social, and economic consequences of current and proposed management actions so that the decision on which management alternatives to select becomes clear.

Additional environmental themes will emerge as more precise and extensive information is provided on large-scale environmental issues. MAIA will continue to be an active participant in addressing these themes by providing integrated scientific information, fostering the formation of stakeholder alliances, and promoting environmental education and stewardship. Public awareness of scientific issues will contribute to improved public and private decisions on environmental management and protection. MAIA is prepared to make a difference in the environment of the 21st Century.